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6. DEVELOPING A REPERTOIRE FOR TEACHING BIOLOGY

INTRODUCTION

In this chapter we describe the rationale and design of a biology method course for preservice biology teachers who are enrolled in the teacher education program at ICLON, Leiden University Graduate School of Teaching in the Netherlands. Before we provide a more detailed course description we will briefly describe the Dutch teacher preparation context. In the Netherlands, there are two different structures to prepare teachers for secondary education: undergraduate programs provided by universities of applied sciences, and post-graduate teacher preparation provided by research universities, like Leiden University. The universities of applied science provide a four year undergraduate program which includes courses on subject matter as well as pedagogy. This program prepares for teaching in lower secondary education (up until Grade 9).

The research universities provide a post-graduate teacher education program lasting one year that leads to a qualification to teach all levels of secondary education. Previous to enrolling in these teacher education programs, participants obtained a Master's degree in the discipline they are going to teach at school. The structure of the program at ICLON includes courses, one day per week at university, plus about 10 hours per week practice teaching at a secondary school under supervision of their placement tutor. The university provides cross-curricular courses on topics such as teaching strategies, classroom management and adolescent psychology. Additionally, the program includes basic and advanced subject-specific method courses both consisting of 9 meetings (3–4 hours per class meeting). Because preservice biology teachers attend courses at the institute and teach at school as well we are able in our course to build on their teaching experiences and to provide conceptual and practical tools for designing (some of the) lessons they will enact at their school.

PLANNING: DISCUSSION OF COURSE DESIGN

In line with the classic proverb that many roads leads to Rome, there are many ways of high quality biology teaching. We believe it is therefore better to replace the common question "What is the best way to teach topic x in biology education?" by

A. J. Sickel & S. B. Witzig (Eds.), Designing and Teaching the Secondary Science Methods Course, 91–107.

the question "How can preservice biology teachers develop their teaching repertoire to allow them to teach biology in multiple productive ways?" A wide-ranging teaching repertoire, so called adaptive teaching expertise, enables teachers to respond flexibly to pupils' varying capacities and interests, to changing teaching contexts, approaches and content. Furthermore, teachers who are able to continuously develop their teaching repertoire are more likely to experience teaching as a challenging and fulfilling activity (Janssen, Grossman, & Westbroek, 2015).

Developing adaptive expertise requires a balance between the development of routines and innovation (Chi et al., 2011). Both a one-sided focus on the efficiency dimension, leading to boredom, and a one sided focus on innovation, leading to frustration and loss of control, is prevented this way.

Teaching repertoire development should enable teachers to implement a wide range of high quality teaching practices. Good teaching is where the three corners of the didactic triangle (teacher, pupil and content) are tuned to each other. In short: in good teaching, pupils acquire *exemplary* content, in a manner that builds on what a pupil knows and can do (*adaptive*) and which is *practical* for the teacher (Figure 1).

First of all, teaching content should exemplify the main ideas and ways of thinking of the discipline (Schwab, 1964) (see Table 7 exemplified in Figure 3). These fundamental ideas and perspectives are what enable the pupils to deal with future new situations and to go on studying more easily later on. As Peters (1973) once remarked, *"To be educated is not to have arrived at a destination, it is to travel with a different view"* (p. 10).

Secondly, the success of teaching critically depends on how it is adapted to the needs and potential of the learners (Table 1). Based on research on effective teaching from multiple perspectives we have summarized the main criteria for adaptive teaching (Corno, 2008; DeCorte, 2010; Muijs et al., 2014). A pupil only learns effectively when he/she is given the opportunity, wants to, is able to and when there is a certain sense of mutual trust. Two criteria can be identified for each of these main categories. We formulated them as questions pupils (i.e., secondary school students) should be able to answer affirmatively after having followed the education concerned.

And finally the design and enactment of the teaching practice should be practical for teachers. Doyle and Ponder (1977) pointed out that teachers do assess educational proposals on their practical usefulness. Proposals which are found practical are likely to be robustly implemented. Proposals which are found impractical are turned down or made into practical ones by teachers in their classroom, though this usually detracts from the essence the educational proposals. Teacher will only consider a new teaching practice practical if cost-effective procedures are available to translate innovative ideals into concrete instruction and if the proposed changes sufficiently fit the teacher's current practice and goals (Doyle & Ponder, 1977; Janssen et al., 2015).

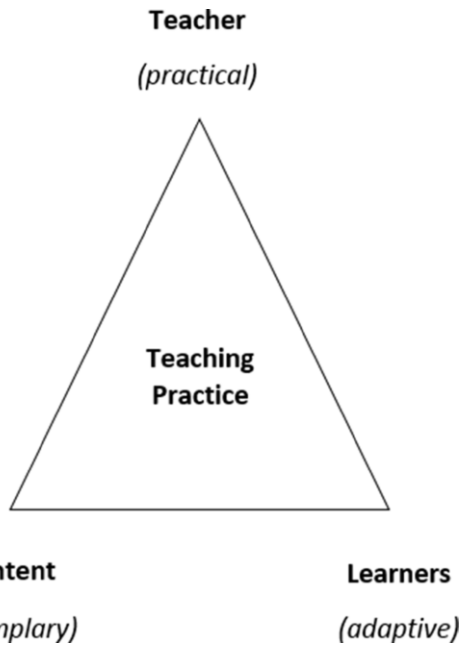

Figure 1. High quality teaching practice is adapted to what individual learners need, exemplifies the core ideas and ways of thought of the discipline and is practical for teachers

Table 1. Criteria for adaptive teaching formulated in questions that pupils should be able to answer affirmatively

	Criteria	
Opportunity	Purposeful	Were you able to practice what you have to be able to do?
	Clarity	Did you know what was expected of you?
Wanting	Interest	Did you think it was interesting?
	Expectation of success	Did you think you would be able to do it?
Being able	Challenging	Was it too easy, or too hard for you?
	Adaptive support	Did you get the help you needed (not too much or too little?)
Trust	Respect/care/understanding	Did you feel taken seriously?
	Autonomy	Did you have freedom of choice? Did you feel in control?

Against this background the question becomes how preservice biology teachers can develop high quality teaching repertoire step by step, building on already existing routines. The two main ingredients are on the basic and advanced biology method courses (each consists of 9 meeting, 3 or 4 hours per class meeting) and the lessons our preservice teachers teach at school (on average 10 hours a week). To develop their repertoire teachers will repeatedly go through a cycle of designing and enacting lessons, looking back on their experiences and what they learned from them, which results in new intentions, based on which they can go through the cycle again (Figure 2). In the course meetings we support preservice teachers to design their lessons. In these lessons they try to incorporate new ways of teaching learned in the course (see Table 5) and they enact these lessons in their own classes at school. In the course meeting we also stimulate them to reflect productively on these teaching experiences.

This notion of developing the repertoire by a cyclic process of designing, executing and reflection on lessons is not a novelty of course (see Dewey, 1910). In these reflection cycles, teachers are stimulated to look back on their experiences and to identify what they have learned. Moreover they are invited to apply what they have learned by formulating resolutions, and design and enact lessons in practice that incorporate these resolutions.

However, we add three elements here which makes cyclic reflective learning more motivating and productive (Janssen & van Berkel, 2015).

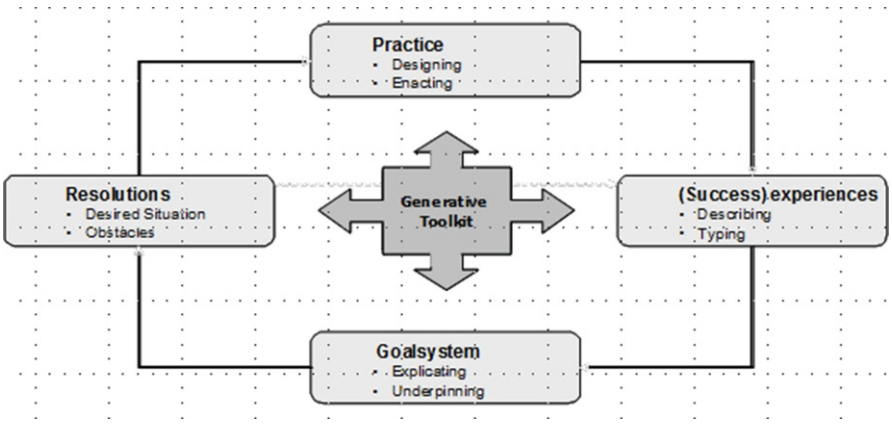

Figure 2. Developing your teaching repertoire by cyclic reflective learning from experience

Toolkit

Our most important addition to the reflective cycle is what we call a generative toolkit. This toolkit consists of theory-based building blocks and rules that preservice teachers can use to (re)design challenging and adaptive lessons in a practical way

by recombining and adapting existing lesson building blocks. We put this generative toolkit at the centre of the reflective cycle because it not only supports the design of lessons, but it also helps preservice teachers to reflect productively on their teaching experiences and with formulating new learning intentions. In other words, the toolkit supports teachers to continuously discover new choices and possibilities concerning the *what* and *how* of the lessons. The toolkit helps teachers to stepwise expand their repertoire of challenging and adaptive lessons.

Later in this section we describe in more detail the nature and content of this toolkit.

Successful Experiences

A second element we wish to stress is the importance of learning from successful experiences (Janssen et al., 2009). In reflective experiential learning, usually learning from mistakes is emphasized. Research shows, however, that it is often hard for teachers to get to productive intentions by reflection on problematic experiences, and being motivated to execute them. In many cases, reflection on problematic experiences results in intentions to avoid such situations in the future. However, if teachers look back on teaching they experienced as successful, this usually results in much more productive and innovative intentions, and they tend to be more motivated to execute these on top of that.

Goal System

The third and last element we add to the regular reflective experience cycles is the goal system as a means of demonstrating compactly what a teacher does and why s/he does it like that. Goal system theorists emphasize that a person's actions in complex situations are often guided by multiple goals simultaneously organized in a goal-means hierarchy and competing for limited resources (Fishbach, 2007; Shah & Kruglanski, 2008). A teacher's goal system represents his/her model practice of teaching, and therefore directs his/her design and enactment of lessons (Janssen et al., 2013) (see Figure 4 for an example of a teacher's goal system).

Summarizing: with the help of the generative toolkit and support of the teacher educator in the biology method course preservice teachers can develop their teaching repertoire step by step by formulating intentions, detailing these into concrete lessons, enact them in his/her school, learning again from successful experiences, elaborating or adapting their goal systems which in turn results in new intentions et cetera.

Before we will illustrate this approach with a case, we describe in more detail the nature and content of the generative toolkit, including the way how elements of the toolkit and related possibilities for design and enactment are introduced step by step in the successive meetings of both the basic and the advanced biology method course.

Our main inspiration for developing a generative toolkit comes from modular innovation in both the man-made (language, cars and computers et cetera) and natural world (like evolution) (Janssen, Grossman, & Westbroek, 2015). All kinds of modular innovation are based on a limited set of building blocks (for instance our Roman alphabet and our genetic alphabet) and a limited set of rules that determine which recombinations of building blocks are viable and which are not. Such systems are sometimes labelled with the term *generative toolkit* because an enormous diversity of innovations can be generated with a limited set of building blocks and rules.

Over the years, the first author has developed and tested a generative toolkit for stepwise development of a teaching repertoire (Janssen et al., 2013b; Janssen & van Berkel, 2015). The basic set consists of four building blocks (explanation, worked out example, whole task and part task; Table 2). Teachers can redesign their lessons both by selectively omitting building blocks and by changing the sequence of the building blocks. The basic set also consists of two rules for selecting and recombining building blocks (whole task first and adaptive support; Table 3). With this basic generative toolkit teachers can expand their repertoire of challenging and adaptive teaching by reversing and selectively omitting existing lesson building blocks. Table 4 shows a concrete illustration of a teacher redesigning a lesson on how the ear works in this way. We refer to Janssen and Van Berkel (2015) for an in depth theoretical discussion of the generative toolkit.

Table 2. Building blocks of the generative toolkit for teaching: Basic set

Building block	*General description*	*Example*
Explanation	The subject matter is presented in general terms.	The teacher explains the structure of the ear and how it works.
Worked-out example	The subject matter is illustrated or demonstrated by an example.	The teacher describes what happens in your brain and ears when you experience 'ringing in the ears' after having listened to loud music.
Whole task	An assignment challenging pupils to use the core of the subject matter in a new situation.	Vincent van Gogh cut off his auricle. Pupils are asked if his hearing is better or worse and how this can be explained with the help of knowledge about the structure of the ear and how it works.
Part task	An assignment demanding pupils to reproduce or apply a small part of the subject matter that needs to be covered.	Pupils are asked to explain the nature of the hammer, anvil and stirrup, and what would happen if the stirrup was missing.

Table 3. Rules of the basic generative toolkit for teaching

Rule	*General description*
Whole task first by reversal	Start the introduction of new subject matter by introducing the whole task. Usually, an existing whole task can be brought forward to this end (reversal) (see example of Vincent van Gogh, Table 4)
Adaptive support help by selective omission	Consider everything you normally offer and do in class as help for doing the whole task. Give pupils only the help that they require (selective omission.)

Table 4. Making a lesson about the ear challenging and adaptive by reversal and omission

Before
The teacher first explains the new subject material about the structure of the ear and how it works. Then the pupils start their part tasks associated with the subject. In conclusion of the class, the teacher brings up the example of the 'ringing ears' and he asks his pupils whether Vincent van Gogh would hear better or worse after having cut off his auricle.
After reversal and omission
Whole task first The teacher starts his lesson on the ear by introducing Vincent and his cut-off auricle and invites his pupils to discuss for two minutes if his hearing is better or worse, and why? *Adaptive support* After the introduction of Vincent, pupils have a choice. They can either start with this task immediately, with just the ear diagram from the textbook to help them, using all terms mentioned in the diagram in their answers to the question. Or they can listen to the teacher's explanation about the structure of the ear before tackling the Vincent assignment.

With only four building blocks and two rules a vast repertoire of challenging and adaptive biology lessons can be designed. The lesson example we just showed is relatively simple in design. The teacher determines the whole task, this task is about a limited amount of subject matter and the options concerning adaptive support are also limited. However, the two rules and four building blocks can also produce different and more complex forms of teaching depending on the amount and nature of the content covered by the whole tasks and to what extent pupils have a say in determining the whole task(s) they are working on. Moreover, adaptive support can be implemented in various forms depending on who controls the adaptive support, how much support is provided and to what extent the support is personalized.

Two expansion sets of building blocks support the teacher to diversify and specify choices concerning the what and how of the whole task and the adaptive support. One set of building blocks is derived from generic theoretical perspectives on teaching and learning (like behaviourism, constructivism, situationism et cetera) (see Table 8). In addition we have developed a domain-specific set representing the core perspectives, questions, methods and fundamental principles of the life sciences (see Table 7; exemplified in Figure 3). These five biological perspectives and related questions (what is it?; how did it evolve?; what is it for?; how did it develop?; how does it work?) are derived from the work of Nico Tinbergen (1963) and updated with new methodological insights about what kind of questions biologists ask and how they try to answer these questions (Bateson & Laland, 2013; Wimsatt, 2007; Bechtel & Richardson, 2010).

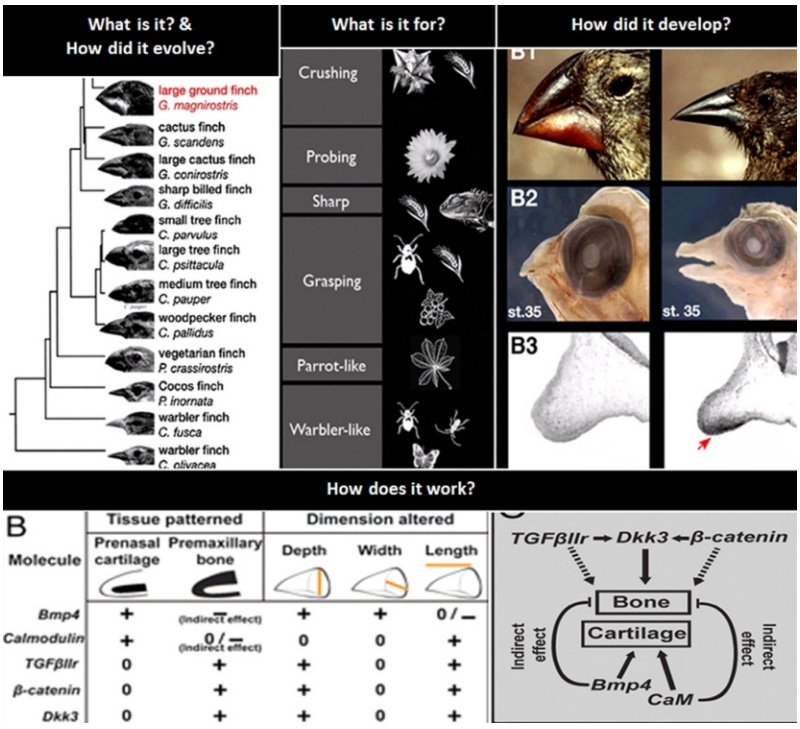

Figure 3. Four perspectives on life phenomena exemplified for Darwin's finches. Darwin's finches are a group of fourteen species. They are classified as the subfamily Geospizinae (what is it?). Their common ancestor arrived on the Galapagos islands about two million years ago (how did it evolve?). The astonishing variation in the shape and beak of Darwin finches reflects a wide range of dietary specializations (what is it for?). Beak shape and size is established by two different developmental modules (how does it work?). Multiple molecules regulate these two modules and can independently alter growth along different axes (how did it develop?). Images are adapted from Mallarino et al., 2011; Rands et al., 2013

Table 5. Outline of the basic and advanced biological method course

Meeting	*Introduction of the parts of the toolkit/Key assignments*	*Biological topics*
Basic Course		
1	Designing a whole task first lesson by reversing (direct instruction lesson)	Organ systems
2	Designing a whole task first lesson + Using the other biological perspectives	Organ systems
3	Using the functional perspective to structure an instructional explanation.	Organ systems and ecology
4	Eliciting and taking into account pupil misconceptions in the context of a whole task first lesson. Using general teaching and learning perspectives	Genetics/Metabolism/ Photosynthesis
5	Designing formative and summative assessments	All topics
6	Supervision/Eliciting your goal system	All topics
7	Designing adaptive support	All topics
8	Orchestrating a classroom discussion on a difficult and/or controversial topic	Evolution
9	Designing and implementing adaptive support (part 2)	Genetics
Advanced Course		
1	Supporting learners to make complex task (metacognitive and domain specific skills).	Topics from the final national school exam
2	Learning by designing. Supporting learner's biological modelling using the functional perspective	Immunology/Ecology
3	Designing and implementing whole tasks and adaptive support that cover a whole chapter	Reproduction and Sex education
4	Converting a cookbook lab into an open inquiry lab	All topics
5	Design and implement a meaningful fieldwork for learners.	Ecology and Environmental education
6	Let learners develop knowledge using perspectives as tools for thinking.	Topics are viewed from all perspectives
7	Alignment and integration between the STEM subjects.	Interdisciplinary topics
8	Analyzing the biology curriculum using the perspectives	Connections between topics and alternative curriculum structures
9	Articulating your goal system learning path and teaching repertoire, again, and relate it to the building blocks of the toolbox.	All topics

With the basic and advanced generative toolkit preservice teachers can continuously develop their repertoire by selecting and recombining building blocks while building on previous successful teaching experiences.

In both the basic and advanced biology method course preservice teachers are introduced step by step to elements of the generative toolkit and the related possibilities for the design and enactment of biology lessons. The preservice teachers come to the methods courses with content knowledge in biology from prior study. But of course they learn (and need to learn) more biology content when they design lessons about specific topics. Therefore elements the generative toolkit are exemplified by certain biological topics.

In Table 5 we describe in more detail in what order elements of the generative toolkit are introduced. We have formulated these elements in terms of the key assignments for preservice teachers for every meeting. The biological topics which exemplify these elements are listed in the right column of Table 5. The sequence in which the elements of the toolkit are introduced is based on three simple-to-complex learning progressions (a) starting with more teacher-centered lessons, working towards more pupil-centered and adaptive lessons; (b) starting with a lesson as a unit of analysis to bigger units like lesson series and the curriculum as whole); (c) starting with using biological perspectives only as tool for designing lesson towards supporting learners to use biological perspectives themselves.

In the two courses spanning one year, preservice teachers develop their repertoire by selecting and recombining building while building on previous successful teaching experiences. In the sections on vignettes of teaching and assessment we will describe and illustrate in more detail how this will work in practice.

CLASSROOM PRACTICE: VIGNETTE OF A SIGNATURE LESSON

We will now demonstrate with a case study of a preservice biology teacher, Ilse, how preservice teachers in our course use the generative toolkit, including the two expansion sets, for shaping their own learning route for developing their teaching repertoire related to the course meetings as described in Table 5. As we already indicated earlier we aim for a learning pathway where a teacher builds step by step on what he/she already knows and can do, so the teacher will stay in flow and avoid both the sense of loss of control and boredom.

We now briefly describe a part of Ilse's learning pathway, starting by a short characterization of her initial situation. We use a so called laddering interview in our course to co-construct a teacher's goal system to characterize a teacher's initial situation. We will first describe the laddering interview procedure and then describe and explain Ilse's initial goal system. The interviewer, either the teacher educator or another preservice teacher, only needs a A3 sheet and a bunch of post-it notes

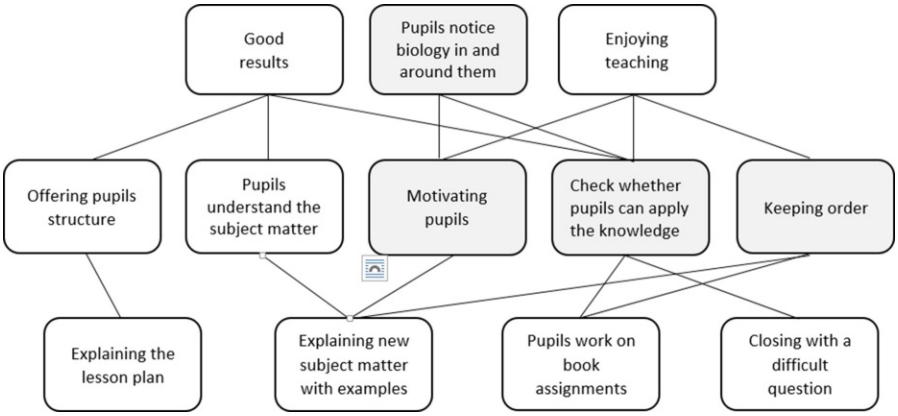

Figure 4. A teacher's goal system

(see Janssen et al., 2013 for a detailed description and justification of the laddering interview).

The laddering interview will proceed as follows:

1. The interviewer asks the teacher to bring a representative lesson to mind, and then describe what he or she does in such a class, and in what order ('from bell to bell'). The interviewer writes every part of the class on separate post-it sheet, in the teacher's wording (the bottom row in Figure 4).
2. Then the teacher is invited to state for each part why he or she thinks this is important. These answers are also taken down literally on separate post-it sheets and stuck unto the A3 sheet. Every part of the class can contribute towards several goals. Every goal – means relation is connected by an arrow. The interviewer can ask more questions about each goal, why the teacher thinks this goal is important, until the teacher has 'arrived' at his/her most important goals (top row in Figure 4).
3. Finally, the teacher is asked to indicate – with a colour or a symbol – which goals from the goal system were realized satisfactorily (white blocks in Ilse's goal system) and which targets were not met as well (grey blocks in Ilse's goal system)

Ilse's goal system indicates clearly how her classes used to proceed in the first months of her teacher education program. After Ilse's explanation of the new subject material, pupils would start doing assignments from the work book. Ilse used to end the lesson by asking a difficult question, to see if the pupils were able to apply the material. She was generally quite happy with this approach, but it bothered her repeatedly that some pupils were not paying attention during her explanation. She

Table 6. Five steps in Ilse's learning pathway. She herself has formulated this pathway

Step	*Related course meeting*	*Intention and Teaching Experiment*	
1	Basic course meeting 1, 2 & 3	Intention	I would like to try whole task first lesson by reversal
		Teaching experiment	An ecology class which I 've ended in another group by challenging the pupils with the following statement by a Dutch politician Marianne Thieme: "A vegetarian in a Hummer is more environmentally friendly than a 'meat eater' on a bicycle", I now start with this statement, and they start working on it after the explanation.
2	Basic course meeting 4	Intention	I would now like to start with real-life context and try the master-apprentice approach next.
		Teaching experiment	The class on photosynthesis starts with a horticulturist's issue of wanting to up his production. I use this case to for explaining photosynthesis. Then the pupils have to come up with an experiment in which they can demonstrate photosynthesis.
3	Basic course meeting 7 & 9	Intention	I want to let pupils choose between direct instruction and guided discovery.
		Teaching experiment	Pupils are assigned to design an artificial heart. They have a choice whether to listen to the explanation first, or immediately start off with the functional strategy.
4	Advanced course meeting 2 & 3	Intention	I have noticed that a complete task instruction is essential for discovery learning.
		Teaching experiment	In a parallel class I taught the same lesson, but now I indicated much more clearly what they have to do, with whom, how, and what they have to deliver at the end.
5	Advanced course meeting 6 & 8	Intention	I want to acquaint pupils with different ways of biological thinking
		Teaching experiment	In the framework of a series of lessons about evolution, pupils could choose an animal and an interesting trait. Then they question the chosen theme from four perspectives, producing a kind of collage with captions, and formulate and visualize the answers by consulting various sources (see Figure 3 on the Darwin finches as an example)

had to warn regularly and sometimes ended the explanation part early and let the pupils work by themselves. She also regretted the fact that she had not yet been able to put an important goal of hers into practice. She was under the impression that the pupils viewed biology as something from a book, rather than realizing it is constantly present in themselves and their surroundings.

She started to develop her repertoire step by step, partly related to new possibilities of newly introduced aspects of the generative toolkit in the course meetings (Table 5), ever building on what she was already doing and using the positive experiences from adaptations she had applied. In Table 6 she herself describes five important steps from her learning pathway and relates this to particular meetings of both the basic and advanced course (second column from the left in Table 6). For every step she stated her intention as well as lesson(s) she designed and enacted based on her intention. These lessons we call teaching experiments.

This learning progression shows how Ilse stepwise developed her repertoire using the toolkit. For instance in the first two meeting the first rule of the basic generative toolkit is introduced and demonstrated: whole task first principle by reversal. Ilse decides to use this rule to adapt her ecology lesson that she already taught in her regular way (explanation first) for another group of pupils.

ASSESSMENT: VIGNETTE OF A SIGNATURE ASSESSMENT

We consider the development of a practical, adaptive and theoretically underpinned repertoire for biology teaching as the overarching goal of the biology method course and related lessons taught at school. As part of our assessment procedure we therefore ask the preservice teachers to document their intentions and teaching experiments in a concise way as was demonstrated in Table 6. Moreover, they need to describe and explain their goal system twice during the biology method course.

Table 7. Typing of each step of the learning sequence with biological perspectives

Subject perspective	*Question type*		*Methods for*	
Taxonomic	What is it?	5	Classifying	
Functional	What is it for?	3 5	Functional analysis	3
Mechanistic	How does it work?	1 2 4 5	Discovery of a mechanism	3
Ontogenetic	How has it developed?	5	Discovery of development pattern	
Evolutionary	How has it evolved?	5	Evolutionary reconstruction	

For the basic course they should describe and justify in more detail two lessons (design, enactment and reflection) of which one lesson is enacted on video as well. For the advanced course they should describe and justify in detail a unit of lessons, with one lesson enactment recorded on video. For both, a report should be included on their pupils' learning outcomes based on formative or summative assessments and pupils' learning experiences. Therefore preservice teachers ask their pupils to fill in a short survey based on Table 1. Finally, preservice teachers should be able to typify and justify their vision on teaching and their learning pathways in

Table 8. Typing of each step with general teaching learning perspectives

Teaching perspectives	*Building blocks for WHAT is important to learn*		*Building blocks for HOW to learn from a positive motivation (Italic)*	*T3*
Behaviorist	Facts and procedures	1	Explanation and exercise with feedback *(reward)*	1
Constructivist	Concepts and strategies	3	Guided discovery based on what you know and can do *(interest)*	3
Socio-cultural	Competencies to partake in social practices	2	Copying from example and participating with decreasing help *(role identification)*	2
Personalistic	Self-knowledge and self-esteem		Reflective experiential learning in a safe environment *(confidence and self-confidence)*	
Outlook on Life	Values and an outlook on life		From traditions, by example and through dialogue *(meaningfulness)*	
Critical	Social criticism and social action		By ideology criticism and social action *(justice)*	
Self-regulation	Learning to learn		Guided planning, executing and evaluating of a learning process *(self-effectivity and self-control)*	
Ecological	Learning what is expected of you in class	4	By whole task instruction (who does what, how and when) *(clarity)*	4
Interpersonal	Social skills		By observing, and adjusting your behaviour *(connectedness/influence)*	
Academic rationalist	Perspectives (ways of knowing and thinking)	5	By critical examination of underlying assumptions *(wonder)*	
Bounded Rationality	Efficient procedures (heuristics)		By example, copying and feedback *(practical usability)*	

terms of general perspectives on teaching and learning and in terms of biological perspectives. In Table 6, Ilse characterizes important steps (1, 2, 3, 4 and 5) of her learning pathway. In Table 7 her learning pathway is characterized in terms of changes in using biological perspectives and in Table 8 in terms of changes in using general perspectives of teaching.

CONCLUSION: STRENGTHS AND AREAS FOR IMPROVEMENT

The rationale and design of the biology method course described here is the result of 15-year design research project. In design research both an intervention and the underlying theory are developed simultaneously in a spiral process of theoretical reflection, design and testing (see Janssen et al., 2013b for description of the main research phases and empirical and theoretical results). The primary aim was to develop an approach that supports biology preservice teachers in developing their teaching repertoire. The secondary aim was to contribute to the development of theory concerning how biology preservice teachers develop their repertoire and how this can be supported. These theoretical reflections were intended to underpin our method and explain the effects observed. We have made considerable progress with respect to both overarching aims. Many research projects on various aspects of our course have demonstrated that the generative toolkit supports preservice teachers to continuously develop their repertoire of high quality teaching practices by selecting and recombining existing lesson building blocks while building on previous successful teaching experiences (see Janssen & van Berkel, 2015 for an overview). Moreover this long term design research project has also resulted in productive theory development on teacher practical decision making and learning (see also Janssen & van Berkel, 2015 for an overview).

Although this design research started 15 years ago it has not been finished yet. The strength of our course is its focus on design. The toolkit supports preservice teachers to (re-)design their lessons in a practical way. However, less attention has been paid to supporting preservice teachers to enact interactive core teaching practices like orchestrating a classroom discussion; creating a classroom culture and helping pupils work together et cetera. We have already explicated the theoretical foundations for integrating design and enactment aspects of teaching (Janssen, Grossman, & Westbroek, 2015), but it will take some more time to actually work this out in practice.

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